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Expert Group Meeting for the Asian
and Pacific Region in Preparation of the
Consultation on the Food-Processing Industry
with Emphasis on Fruit and Vegetable Processing

Beijing, People's Republic of China
22-24 November 1988

# BACKGROUND PAPER*

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* The views expressed in this document are those of the author and do not necessarily reflect those of the UNIDO Secretariat. This document has not been edited.

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## I. EXECUTIVE SUMMARY

In implementation of the mandate of the UNIDO conference, according highest priority to the Consultation on the Food-processing Industry, with emphasis on the processing of fruits and vegetables, preparations are underway to convene the regional preparatory meeting for the Asian and Pacific region, which is scheduled to be held at Beijing, by the end of 1988. This paper has been prepared to provide the necessary background, and to highlight the importance of the industry for the region. The issues have been elaborately discussed and possible solutions suggested. The paper discusses the evolution of the processing technology, contains description of technologies used, including the impact of food bio-technology, constraints and obstacles, and policies and strategies.

In view of the vast potential for the development of the industry, and the recent reorientation of policies in many countries, particularly in liberalizing procedural restrictions, there is unlimited scope for North-South and South-South co-operation.

The above fact has been borne out by the increasing number of NICS in the region. Thailand is fast moving towards its inclusion as a new member of this exclusive club. It has also a flourishing fruit- and vegetable-processing industry, besides a number of other agricultural raw material processing industries.

It is increasingly being realized that small- and medium-scale enterprises (SMEs) provide ample opportunities for private foreign investment and joint ventures, as also for building a flourishing private sector. The advant of new agricultural and industrial processing technologies has given a philip to the growth and development of SMEs.

The importance of the industry could be readily recognized by the fact that the developing countries could exploit their comparative advantage, as the region abounds in the production of a large variety of fruits and vegetables, including the exotic ones, and the industrial processing of these commodities creates employment, income distribution, and will spread social justice, make nutritious food, rich in vitamins and minerals available to the

population, and also earn considerable foreign exchange by building integrated agro-industrial complexes, and exporting products at internationally competitive quality and price, wherever the conditions are favourable, and indeed, as some countries have eloquently demonstrated the success of such industrial processing and building of integrated agro-industrial complexes.

According to one report, only 50 per cent of the produce grown in developing countries is marketed off farm. Of this, about 10 per cent is exported, and 2-3 per cent is industrially processed. The developing countries still account for about only 4 per cent of world production. It has also been mentioned that the share of the developing countries in world exports of preserved fruits accounted for only 36 per cent and their share in the total world exports of fresh, frozen, or preserved vegetables amounted to 35 per cent. Only a few countries account for the largest part of production and exports.

Tentatively the following main problems were mentioned by the Industrial Development Board of UNIDO as potential issues for further deliberation:

(a) Criteria for selecting the most suitable technology or the choice of technology, and

(b) Problems of quality control, standardization, and observance of health and safety regulations.

Packaging has been singled out as the single most serious constraint, as it amounts to nearly 40-50 per cent of the cost of the product. There are various other constraints and obstacles, such as lack of infrastructure, low agricultural productivity, and poor quality of the raw material, inadequate processing technology, lack of management abilities, multiple taxation, etc.

The policies and strategies are critical as they will influence the rapid growth, development, and expansion of the industry; per contra, inappropriate policies could have the opposite effect. However, this is a sensitive issue, on which the national governments take decisions, keeping in view their overall development objectives. Liberalization of procedures, licencing, etc.

could attract unlimited private foreign investment, flow of modern technology, and possibly result in the establishment of joint ventures, all of which could create a flourishing private sector with unforeseen benefits to the economy as, in fact, it has been done in the case of Newly Industrialized Countries or NICS, in the region.

In the policy reorientation, the over-riding consideration has been the strengthening of the linkage between agriculture and industry. Processing of fruits and vegetables is just one example.

The criteria for adoption of processing technology has been discussed. This includes thermal processing, freezing, dehydration and concentration, irradiation, fermentation, food biotechnology and dried fruits and nuts.

In view of the difficulty of collecting up-to-date and factual data on the status of the industry in different countries, the analysis presented may appear to be somewhat incomplete and distorted. It is expected that the participants in the regional preparatory meeting will make valuable contributions to the deliberations, which may result in preparing a status paper, and to serve as background material for future activities in this field, such as the formulation of guidelines for the development of the industry in a long-term perspective.

## II. CONCLUSIONS

In this section, an attempt has been made to draw some conclusions and arrive at some specific suggestions for deliberation at the regional preparatory meeting to be held at Beijing, November 1988.

- National policies and strategies are of critical importance, and therefore they should be reoriented.

- There seems to be unlimited scope for North-South co-operation, especially for private foreign investment and establishment of joint ventures.

- The governments concerned may wish to make full use of their comparative advantage, and build or strengthen an export-oriented industry.

- Case studies could be carried out, of both successes and failures by UNIDO, and guidelines provided for the benefit of the future development of the industry, and fuller exploitation of the domestic resources and utilization of comparative advantages.

- South-South co-operation could be further strengthened as, in fact, it is being witnessed among the ASEAN countries.

- Technical assistance is required for the induction of modern processing technology. UNIDO could play a central role, in organizing technical co-operation projects.

- In the interest of encouraging small-scale industry, development of dried fruits and nuts as an export-oriented industry, should be strengthened.

- The critical areas of constraints, such as packaging may receive urgent attention of UNIDO. It is common knowledge that some countries have established National Institutes of Packaging to intensify research and development, so as to resolve the critical problems and to come up with innovations in the broad area of packaging for processed industrial products.

- UNIDO's technical assistance may also be required in strengthening the facilities for quality control and standardization of products. More so, in the protection of health, preventation of adulteration, and enforcement of regulatory measures.

- Necessary climate should be created to attract private foreign investment and joint ventures. This is largely for national governments to decide in the context of their development plans and programmes.

- Indigenous Research and Development should be strengthened to build equipment and machinery.

- The issue of multiple taxation reported to be a hindrance seems to be a matter of individual governments to examine and take appropriate decisions.

- It is needless to emphasize the human resources development.

- Due consideration may be given to the establishment of integrated agro-industrial complexes, as has been done in the Philippines and Thailand.

- Co-operation with transnational corporations with adequate safeguards would hasten the process of development of the industry.

- Institutional arrangements for export promotion and development of new markets by the establishment of export promotion authority, or similar statutory body, wherever it is justifiable is proposed.

- Workshops and seminars should be organized for the exchange of experiences among the developing countries, with the active support and co-operation of the importing-developed countries and UNIDO.

- UNIDO may wish to actively promote inter-country co-operation both at the sub-regional and regional level so that an institutional infrastructure, under the UNIDO auspices could be established.

- A regional fair of the industry involving all aspects from agricultural production, industrial processing, equipment and machinery required, marketing, standards, quality control, regulatory measures, etc. may be organized by UNIDO in co-operation with the host country in the region.

## III. INTRODUCTION

1. The second session of the UNIDO General Conference held at Bangkok, Thailand, 9-13 November 1987, while considering the proposed programme and budgets, 1988-1989, as recommended by the Industrial Development Board 1/, inter alia, endorsed the Consultations on the Food-processing Industry, with Emphasis on Fruit and Vegetable Processing. This was in line with the recommendation of the Second Consultation on the Food-processing Industry, to examine the existing constraints to enhancing the industrial output in the subsector and to identify measures required to overcome them, including the selection of most suitable technologies, as well as packaging. The Conference also accorded highest priority to the Consultation on Food-processing Industries.

2. In accordance with the above-mentioned mandate, and in line with the policy directives of the two conferences of UNIDO, and the sessions of the Industrial Development board, since UNIDO was transformed into a specialized agency, there has been an increasing emphasis and a new focus on the development of agro- and allied industries, and small- and medium-scale enterprises (SMEs).

3. There is immense potential for processing indigenous agricultural raw materials, including fruits and vegetables, in the developing countries of the region. Their development on modern lines would serve the purpose of import substitution, and more particularly, of augmenting foreign exchange earnings by the export of manufactured products of high quality. The technology and machinery required for industrial processing of agricultural products, including fruits and vegetables are available within the region. However, inview of recent liberalization of policies and conscious efforts being made in most developing countries to invite joint ventures and private foreign investment, there appears to be unlimited scope for North-South co-operation.

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1/ UNIDO Doc.GC.2/10, 10 September 1987, Proposed Programme and Budgets, 1988-1989, page 116.

This is in recognition of the new awareness in the developing countries of the advantages of such co-operation in the field of agro-industries, viz., contribution to GDP, export earnings, and especially employment generation and income distribution, thereby promoting the social objectives of industrialization.

4. The guiding principles of UNIDO in the development of agro-based industries have been an uncompromising emphasis on issues of poverty, unemployment, income distribution and social justice, as being central to the meaning of development. It is in pursuance of the above mentioned dynamic policies that some countries in the region have produced spectacular results in the recent past. A dramatic transformation has been brought about in the industrial processing of agricultural raw materials in some countries and their economic indicators have placed them in a group known as "more developed among the developing countries". Exceptionally, few countries have acquired the distinction of Newly Industrialized Countries (NICS). Thailand 1/ is moving very rapidly towards attaining this unique distinction, in the Asian and Pacific region. Thailand's modest but growing riches work out US$ 1,000 a year per person, according to the Economist 3/.

5. It is common knowledge that the industrial processing of fruits and vegetables is an important sub-sector within agro-based industries. The advent of new agricultural and industrial processing technologies has given a philip to the growth and development of small- and medium-scale enterprises (SMEs). SMEs assist in diversification, provide ample opportunities for private foreign investment and joint ventures. It is increasingly being realized that SMEs provide excellent opportunities for dynamic growth and development of the private sector. The SMEs are particularly suited for capitalizing on entrepreneurial skills, initiative, and talent, thus assisting in building a flourishing private sector in the developing countries of the region.

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2/ Newsweek, June 27, 1988, pp 6-12, Asia's Emerging Superstar.

3/ The Economist, June 25, 1988, p. 26.

6. In brief, increased industrial processing of fruits and vegetable in the developing countires of the region will serve as a further example of the strengthening of the linkage between industry and agriculture. The modern technology, both in the production of the industrial raw materials of a high quality, and the industrial processing and utilization of the byproducts, standardization of products, introduction of quality control, inspection and regulation, needs to be extensively employed to derive maximum benefits to the economy. The sub-sector is of great importance to the region, as it abounds in the production of not only the traditional fruits and vegetables but also in some exotic varieties, by the processing of which, a large-scale export-oriented industry can be developed. In fact, the more enterprising countries have taken advantage of this situation and have built large number of integrated agro-industrial complexes, such as processing of pineapple, citrus and some exotic fruits and a variety of vegetables. While this is an optimistic view, one should hasten to add that among the many constraints encountered in the developing countires, packaging is of critical importance. On the other hand, it is the high cost involved in modern packaging, and on the other, the lack of technical know-how and the ancillary units to produce the most suitable packaging materials, which the processor can afford. There are, however, some countries which have been able to tackle this problem in the same manner as acquiring modern processing technology.

7. In view of time and resource constraints, it has not been possible to elaborate further, except to focus on the two critical issues, a detailed discussion of which is contained in subsequent sections of this paper.

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4/ The information discussed in this paper is based on the accumulated knowledge and experience of UNIDO Out-Posted Senior Officer in Bangkok for development of agro- and allied industries in the region. In addition, specific reference has been indicated to the source of information, wherever it is warranted, as footnote, on the relevant page.

## IV. ISSUES FOR CONSIDERATION

8. The Industrial Development Board (IDB) of UNIDO has approved the Consultation on the Food-Processing Industry with Emphasis on Fruit and Vegetable Processing 5/. This is an area for which immense potential exists in the developing countries. However, the industrial processing of fruits and vegetables in the developing countries still remains a fraction of the total production. It is said that according to FAO estimates, only 50 per cent of the produce grown in developing countries is marketed off farm. Of this, about 10 per cent is exported and 2-3 per cent is industrially processed. It is further stated that although the growth rate of the fruit and vegetable processing industry is four times faster than in industrialized countries, the developing countries still account for about 4 per cent of the world production. The development of the fruit and vegetable processing industry in developing countries could contribute to the reduction of post-harvest losses of fruits and vegetables, would have the advantages of increasing the value added of agricultural products, increasing the availability of food of a high quality to the population, and raising the incomes of farmers.

9. It is generally believed that in view of trends in the world markets and the expansion of domestic demand, the outlook for the fruit and vegetable processing industry is favourable for developing countries, which have a comparative advantage. The agro-climatic conditions are excellent in many of the developing countries in the region, facilitating the production of juice from tropical and subtropical fruits, as well as dried, frozen, and canned fruits and vegetables. The products that could be processed in developing countries present a large range of items, and there appears to be room to expand production. According to an estimate, a few years ago, the share of developing countries in world exports of preserved fruits accounted for only

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5/ UNIDO Doc., IDB. 2/14, Dtd. 12 August 1986, Programme of Consultations 1988-1989 biennium, paras. 19-23.

36 per cent, and their share in the total world exports of fresh, frozen or preserved vegetables amounted to 35 per cent. In the region, among the developing countries, only a few countries account for the largest part of fruit and vegetable production. This includes processing and marketing (both for domestic consumption and for exports).

10. In consideration of the foregoing, and without prejudice to the conclusions and recommendations of the preparatory meeting, it is believed that the proposed Consultation should concentrate on existing constraints to enhancing the industrial output of the fruit and vegetable processing sub-sector, and on identifying the measures needed to overcome them. In particular, the Consultation could consider the following two issues:

(a) Criteria for selecting the most suitable technologies for successfully developing the subsector; review of alternative technologies could include canning, freezing, bottling, dehydration, preserving, pickling, extraction, frying, toasting, fermentation and irradiation, as well as packaging. The availability and cost of appropriate packaging is the single major obstacle preventing the fruit and vegetable processing industry from reaching its full potential in many developing countries. Packaging costs, which range up to 50 per cent of the ex-factory costs, are often more important than raw material input prices in determining the competitiveness of a country's fruit and vegetable processing industry. Special efforts should be undertaken to develop methods and types of packaging that could permit the sale of processed foods at prices the producer countries could afford, both for domestic consumption and for development of a stable export market.

(b) Problems of quality control, standardization, and observance of health and safety regulations in the sub-sector.

11. It would be useful to consider the constraints in the industrial processing of fruits and vegetables in the developing countries. In common with other agricultural raw-material processing industries the obstacles impeding the development of this sub-sector are low levels of agricultural

productivity, inadequate processing technology and know-how, lack of quality control, lack of research and development facilities, and hence inability to develop indigenous technology and lack of absorptive capacity of the imported technology. Associated with this problem is the difficulty of exercising a choice in technology. However, it should be added at once that there are exceptions to this general picture. Some countries notably the Asean countries, for e.g. the Philippines and Thailand have most modern technology for processing fruits and vegetables, by virtue of the liberal policies of the governments, wherein there is a thriving private sector operating through joint ventures and private foreign investment. They process both traditional and exotic products for domestic consumption and exports. It is of particular interest to refer to the integrated agro-industrial complexes which have been built, for example, for processing pineapple and a variety of fruit juices. Although the cost factor in packaging has been pointed out earlier, the complexes referred to, seem to be setting the pattern for a dynamic private sector industry.

12. Therefore, one critical factor in the development of the processing of fruits and vegetables, as in the case of other agro-based industries, is the adoption of liberal policies by the government. One would argue that it is true of all industries and would go a step further and bring in the question of privatisation, or legislation to permit the take over of industries by the private sector without government interference. There are no two opinions in the matter. Because of the sensitive nature of the issue, individual governments would wish to take decisions in the overall context of their development policies and strategies. However, the sub-sector under discussion being agro-based and attendant with numerous problems, it was thought necessary to emphasize the policy and strategy angle, in view of the comparative advantage that the tropical and semi-tropical countries in the Asian and Pacific region possess, in the industrial processing of fruits and vegetables, which could be exploited to strengthen their agro-industrial base, concomitant with socio-economic benefits to the country.

13. With the above background, which pertains to policy and strategy constraints, it may be useful to examine other constraints of infrastructure, technology (choice of technology), acquisition of processing know-how, machinery and equipment, packaging, standardization, quality control

and regulatory measures, and also human resources development.

14. In an overview 6/ of the fruits and vegetables processing industry, in the first Global Study of UNIDO on the Food-Processing Industry it is observed, as an example, the growth and expansion of the canning of the pineapple industry in the Philippines and Thailand. Reference has also been made to the rich and delicious fruit juices made of pineapples, oranges, guavas, lime, papaws, mangoes, etc. The processing industry is said to be most successful in supplying products for the domestic market requiring the least packaging, e.g., banana and guava pastes, or in supplying concentrates for export, e.g., oranges, where again, the cost of packaging is a small percentage of product value. Here again it is emphasized that the availability and cost of appropriate packaging is the major single obstacle preventing the fruit and vegetable industry from taking off to its full potential in the developing countries. The crucial importance of this cost item to the industry's development is due to the fact that retail-size packaging costs, metal cans, labels and cardboard boxes make up between 40 and 50 per cent of ex-factory costs; then, they are more important than raw material input costs in determining the competitiveness of a country's fruit processing industry. Fruit input costs are another obstacle in the way of a modern fruit-processing sector in the developing countries. Owing to the low yields per hectare, fruit input costs are, often, too high by international standards and in some cases the price paid by plants for fresh product input is considered unremunerative by the farmers and other producers. This is, of course, a problem not limited to fruit and vegetable processing, but related to the general conditions of production of the agricultural products and the sharing of the benefits between the producer of primary commodity and the industrial processing unit. This raises the complex issue of terms of trade. Government intervenes by setting up agricultural prices Commission or similar authority to determine equitable sharing of benefits, especially in economies, which are not market-oriented. A further important obstacle is the high cost of transport in general, both inland and for exports. Finally, there is

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6/ UNIDO Doc. ID/WG.345/3/Rev. 1, Dated 23 September 1981, First Global Study on the Food Processing Industry, pp 19-20.

compromise to be studied in each case between the fraction of production that can be marketed fresh and the fraction that will be processed, particularly from the point of view of energy, transport, storage, and packaging. The International Trade Centre-UNCTAD GATT, ITC, in its publication, promoting packaging for exporters 7/ makes reference, inter alia, to the packaging of fruits and vegetables, technical assistance provided to developing countries, the existing national institutes of packaging etc. The reference to national institutes is mentioned under each country report in a subsequent section, to the extent the information was available at the time of writing this paper.

15. Historically, 8/ canning emerged as the successful method of preserving foods, with various refinements until the 1920s. In recent years, the frozen foods industry has developed greatly, and is said to challenge canning for many types of food, though it seems certain that canning will retain a segment of the market where it holds special advantages. The invention of mechanical refrigeration systems in the latter part of the nineteenth century led to the development of cold storage, and the beginning of the vast refrigeration industry. Rapid freezing at low temperatures was early recognized as fundamental to achieving a good frozen product, but it was not until the 1920s that patents were taken for quick frozen foods. It is said that the General Foods Corporation in the United States of America purchased these patents, who put out their frozen food packs around 1930. Development was slow, owing to the need to establish, at great expense, a freezer chain from factory to the consumer, and it was not until the 1940s that frozen foods began to make headway, in the United States, as by this time, many American homes possessed refrigerators. In other countries, developments were much slower and frozen foods became popular only in the 1960s.

16. Drying is one of the oldest forms of food preservation. A vegetable dehydrator, which used hot air (46 C) flow over thin slices of vegetables was developed in 1785 in France. It is said that canning was invented at about the

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7/ Promoting Packaging for Exporters, 3 Vols. International Trade Centre, UNCTAD/GATT, Geneva.

8/ Key Guide to Information Services in Food Science and Technology, Syd Green, pp 3-5, Mansell Publishing Limited, London, England.

same time in France. A new preservation process, food irradiation, was introduced in the 1950s but, as yet, has found only limited applications owing to doubts about its safety, and problems with off flavours at high dosage levels. Some products have been cleared for use and the list is growing. The earliest food legislation was concerned largely with assisting trade, or the maintenance of the revenue, but subsequently, became very much concerned with the prevention of abuses, and was directed at three areas, viz., adulteration of foods, misbranding of foods, and false advertising of foods. At about this time, it became possible to detect adulteration of foods by chemical or microscopic methods, which helped in the enforcement of legislation.

Processing Technology

17. With the above background of summarization of the issues, it may be useful to consider the processing technology although the choice, as has often been debated, will depend on individual conditions for a particular industry, such as processing fruits and/or vegetables. The operations which transfer the agricultural raw materials into valuable products of commerce are many and demonstrate food technology in action. Such conversions add value appreciably and enhance safety, quality, stability and convenience. The following is a brief description of the processing technologies 9/.

Thermal Processing

18. The efficient high temperature/short-time thermal treatment of aseptic processing minimizes damage of sensitive flavours, such as in tropical fruits, and process flexibility permits operations from bulk sterilization to retail single portion packaging. Skilled labour is required and the operation must be practically continuous in order to be economical. The efficiency, versatility, and quality potential are worth considering. An aseptic line can be integrated with fresh product handling or processing of discrete particles (slices, chunks, etc.).

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9/ Food Technology, May 1987, Processing Alternatives for Tropical Exports, pp 110-114.

Freezing

19. The quality-retaining potential of freeze preservation can be realized in the tropics only where frozen storage and transportation capabilities exist. Central freeze-processing is a feasible enterprise, even to the extent of air shipment, when the food value warrants the additional expenses. Such an infrastructure can tie in well with the handling of fresh produce, where temperature control and careful scheduling of harvesting and shipping are even more critical than with frozen foods.

Dehydration and Concentration

20. The weight and bulk reduction and enhanced stability of dried foods can facilitate tropical food handling, provided that quality is retained. The major food staples and other items of international trade are often based on solar drying; cereal grains, grain legumes, spices, coffee, cocoa, and tea are some examples. More widespread use of such methods in the tropics depends upon efficient dehydration equipment, hermetic packaging, and sound storage facilities.

21. Concentration of fluid foods when tied in with frozen storage, likewise, is a practical preservation method. Highly flavoured fruits such as passion fruit, guava, and lime could be converted into natural concentrates. By mere addition of sugar to the frozen product, the juice is converted into nectar bases, without the need for concentration.

Irradiation

22. Although irradiation is a proven pasteurization and sterilization process, its initial and most urgent use in developing countries will probably be for insect deinfestation, as a replacement for chemical fumigants to meet the fresh produce quarantine requirements of importing countries.

Fermentation

23. Tropical fruits are underutilized. It has been suggested that tropical fruit wines could be produced, if proper research and experimentation is carried out. Fermentation technology now means much more than traditional foods. One of the dramatic findings in recent years has been the development of high-fructose corn syrup which is said to have irreversibly diminished the use of cane sugar in developed countries. However, bio-technology applied to the tropics will eventually enhance the quantity, quality and diversity of tropical foods as raw materials and ingredients for processing. Tropical foods are in a position to both lose and gain international markets. One difference is that the pace of innovation and obsolescence is much faster today.

Food Bio-technology 10/

24. It is perhaps useful to make a brief reference to the impact of biotechnology on food-processing, even when we are discussing just a single sub-sector of the industry. It is said that while during the last two decades food research and development were marked by work on proteins, energy concerns, consumerism, food quality and safety issues, the present and the next decade are likely to be concentrated on bio-technology and natural products. The demand for natural products has prompted the increased use of biological production and processing systems, such as fermentation for preservation purposes, and micro-organisms and bio-catalysts from plant origin for flavour production. The production and utilization of fuel alcohol, and the worldwide attempts to increase plant resistance to pesticides, drought, or high salt concentration, exemplify the impact bio-technology has on food production.

25. The European Federation of Bio-technology, has defined Bio-technology as "the integrated use of bio-chemistry, micro-biology and engineering sciences in order to achieve technological (industrial) application of the capabilities of micro-organisms, cultured tissue cells and parts thereof." Alcoholic

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10/ Food Technology, April 1987, Food Biotechnology, Its Organization and Potential, pp 95-99.

beverages, cheese, vinegar and sour dough production are the most prominent examples of highlighting the fact that the food industry is the oldest user of biotechnological products and processes.

26. During the pre-Pasteur era, biology had little scientific basis. Even the discovery of micro-organisms as the smallest living creatures in 1650, did not lead to any real understanding of their significance. Louis Pasteur's proof that living microbes are the active agents of fermentation was the first step from the descriptive biology towards a real understanding of biological processes. His discoveries led to improvements in the artisan bio-industries for making wine and vinegar.

27. During the antibiotic (pharmaceutical) era, different disciplines such as microbiology, biochemistry, and process engineering contributed to the newly developing fermentation industry. Conventional technologies derived from the food processing and chemical industries were applied to the fermentation industry.

28. The post-antibiotic era was marked by the "metabolic engineering", the systematic exploitation of the capabilities of microorganisms to produce a variety of metabolites and enzymes. One relevant breakthrough was the large-scale enzymatic conversion of starch to high fructose corn syrup, to which reference has been made earlier.

29. The era of new biotechnologies is dominated by controlled sciences such as genetic engineering, and computer-controlled bioprocesses.

30. In the context of the above discussion it would appear to be useful to refer to the dried fruits industry 11/, which is of particular interest to the tropical-developing countries in the region. Prominent among the large number of fruits produced are banana, pineapple, and mango. There are a large number of other fruits, all of which have exotic flavours, textures, and appearance.

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11/ Food Technology, May 1987, Post-Harvest Handling of Fresh and Dried Tropical Products, pp. 120-122.

Among the many problems in marketing these products, is the short shelf life of 1-4 weeks. For tropical countries that are a considerable distance from the markets, shipping by sea is the most economical method, but it is slow. Unless the whole systems from production through packaging and shipping is well organized only sub-standard quality produce with low sales appeal will be available. A classic example of successful operation is the banana industry, which markets a large volume of bananas throughout the temperate world. Air freight is expensive. The fruit or vegetables must command a high price in the retail market to cover the cost of air freight. The whole operation need to be well organized to maintain temperature and humidity control to deliver the produce in top condition. This requires a big operation and is not suited to a small business. The export of canned or frozen tropical fruits is a well established industry but it also demands considerable resources which place it out of reach of all but a few large organizations.

31. An alternative to small-scale processors is to dry the fruits and to convert them into stable products of longer shelf life of about a year. The advantages of drying are:

-A more concentrated product than the fresh fruit. This reduces the cost of storage, packaging, and freight. For example one ton of fresh apricots, when dried, will weigh only 450 lbs.

-It is less costly than canning or freezing.

-It converts products into a stable with longer shelf-life.

-Capital costs are low

-Farmers can harvest their produce and dry them as and when they become available.

-It is possible to grow and dry fruits in small units. It is not necessary to have large plantations or orchards, which are usually demanded for fresh-market fruits such as bananas.

-Such operations are labour-intensive.

32. The annual world production of such dried fruits viz, apricots, dates, figs, prunes, raisins, and currants is 1.2 million tons representing 4.6 million tons of fresh fruit. The drying ratio (number of pounds of fresh fruit required to produce one pound of dried fruit) is: apples 7-10, apricots 5.5.-8.5, figs 3, peaches 6-8.7, pears 6-7, prunes 2.75-3.25, and raisins 4-5. The United states of America is reported to be importing dried fruits of a total value of U.S.$ 26.5 million per annum.

33. While the fruits referred to above are from semi-tropical region, it is reasonable to believe that some tropical fruits will lend themselves to drying into a quality product with the potential for a large-volume export business, if suitable drying technologies are adopted. A good system would be to dry the fruit on the farm, and then bring it to a central packing house with large-scale operation catering to a large number of producers. The Dried Fruit Association of California (DFA) came into existence in 1908 and is said to have served the fruit industry very well. The services rendered are:

- Standardization
- Disease and pest control
- Research
- Sanitation
- Liaison, and
- Grade standard inspection service

34. DFA has helped to build a sales volume in excess of one billion dollars per annum in dried fruits and nuts.

## V. STATUS OF THE INDUSTRY IN SELECTED COUNTRIES IN THE REGION

35. In this section, an attempt has been made to present a brief picture of the processing of fruits and vegetable, in some selected countries. This information will cover briefly, the two issues, as elaborated in the section under the Issues for consideration. As this paper had to be written in less than 6 weeks' time, and owing to time and resource constraints and lack of information and data on country situation, the material presented in this discussion paper could be treated as representative of the situation in the developing countries in the region. In view of the fact that the People's Republic of China, as the host country for regional preparatory meeting for the Consultation to be held in Beijing, some time by the end of 1988, will present a comprehensive and basic paper on the industrial processing of fruits and vegetables, and will cover the issues discussed earlier in this paper, no attempt has been made to include any information on that country.

36. In the following paragraphs, the readily available information on some countries is presented.

PHILIPPINES

37. The report on the Philippines is based on a document of the World Bank 12/. There are forty-two processing plants with facilities for canning, bottling, dehydration, freezing and pickling of fruits and vegetables. With exception of the pineapple processing industry, for which supplies of fruit are available throughout the year, most other processors are subject to seasonal factors with regard to raw material supplies. Consequently, capacity utilization is estimated between 25-50 per cent. The location of existing fruit and vegetable processors is a potentially serious constraint. Out of the 42 units, 35 are located in or around the Metro Manila area, which results in high transportation costs and product deterioration.

38. Tropical fruits are well suited for contract farming arrangements. It is stated that some of them are particularly attractive in the current economic environment because of their short gestation period. But the production of others with long gestation periods, most notably mangoes, should also be encouraged since they offer high returns and can contribute to economic growth in the longer run.

39. The peak production of some of the important fruits and vegetables are mangoes 400,000 tons, papayas 105,000 tons, bananas 3.67 million tons, pineapples 1.0 millions tons (Dole and Delmonte). Among vegetables, tomatoes 103,000 tons, beans 4.500 tons, onions 42,000 tons. After bananas, pineapple of over 1.0 million tons is the second major fruit crop. A large percentage of this supply is grown by Dole Inc., and Del Monte on their own plantations. Their mechanized cultural practices, mechanically assisted harvesting and integrated fresh packing and processing operations appear to be highly efficient. Pineapples are harvested year-round with only small crop peaks in summer and winter and minor seasonal variation in quality.

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12/ The Philippines Food Processing Sector, Development Potential and Constraints, Report NL 5503-PH, document of the World Bank.

40. Export of processed fruits and vegetables increased from US$ 64 million in 1970 to US$ 137 million in 1982. The sector has been dominated by pineapple products which, at one time had a share of 87 per cent but has since declined to 78 per cent. A large proportion of pineapple exports are handled by the two leading transnational corporations, viz., Dole and Delmonte (manufactured in the Philippines by Philippines Packing Corporation, PPC). Exports of canned and preserved fruits other than pineapple products amounted not more than US$ 17 million.

41. The establishment of a packaging centre within the design centre of the Philippines is mentioned. The report recommends a package design facility geared to meeting the needs of specific products in specific markets. In the report it is also recommended that FDA technical assistance and enforcement functions should be separated.

42. The National Science and Technology Authority (NSTA) is the overall planning body in science and technology under which the Philippine Council for Agriculture and Resources Research and Development (PCARRD) functions.

43. The Head of the Department of Agriculture in Manila has said 13/ that the country must create the right environment for foreign investment. The government's role is to support the private sector. The aims are to free market forces, privatise where necessary, and provide access to land, credit, capital, and technology. At the same time it is proposed to integrate and reorganise those government offices that are involved with the agricultural and rural sectors. It is also said that much of the future success would depend upon provision of sufficient agricultural financing, improvements in the marketing of agricultural products, strengthening agricultural support services and to introduce a balanced agro-industrial development strategy.

44. In the marketing of agricultural products, the role of the government is confined to providing the policy framework and the public investments needed to draw private initiative into the marketing of agricultural goods. Except

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13/ Far Eastern Agricultural, Nov./Dec. 1987, pp. 16-17.

for corn and rice, the government itself will not engage in any form of marketing. Its role in respect of other commodities would be to ensure that output and input prices reflect their social opportunity costs and that these prices correctly signal changes in supply and demand for the guidance of producers and consumers; to see that market infrastructures and transport facilities are functioning effectively at the least possible cost to the private sector; and to develop a reliable market information service.

45. Foreign investment is welcomed in the agricultural and agri-business sectors, with the accent on joint ventures and partnership arrangements, particularly for contribution of expertise, experience, and finance. Reference has been made to pineapple, for which the domestic demand is said to be increasing by 10 per cent per year, though this may decline in the next decade. Exports are bullish with forecasts reaching 450-495 million kilograms by 1990, and considerably more by 1995 bringing opportunities for small- and medium-sized processing operations to preserve the fruit for marketing.

46. With reference to agro-industrial strategies, it has been said that the kind of investments that the government would like to see are those that will foster the small- and medium-scale, labour-intensive enterprises in the country side, which would use indigenous raw materials to the greatest possible extent. Priority would be given to agribusiness firms which tie up with small farmers and will help to improve competitiveness of Philippine products on both international and domestic markets. The authorities seem to be confident that they have come a long way already and are creating a much more stable environment for foreign investment and are looking at products that will sell well in overseas markets.

THAILAND

47. Extensive consultations were held in Bangkok with the Ministry of Industry, in the Foreign Relations Division, in the Industrial Promotion Department, Divisions of Economics and Planning. Also in the Thai Institute for Standardization, Board of Investment, Thai Industry Association (fruits and vegetables). The establishmente of two processing plants in the North in collaboration with the West German government is under active consideration of

the government. The Thailand Institute of Standardization has issued standards for a number of processed fruits and vegetables. There is a well organized quality control system for processed products. The certification scheme conforms to ISO certification, type 5. Testing is done for certified products both from samples drawn from the factory and those collected at random from the market. In respect of regulatory measures, government has reserved the right to make some standards compulsory for example, canned pineapples.

48. Even though fruit crops constitute a significant portion of the agriculture sector, it is considered, in some quarters, to be neglected in the past. This is largely due to the fact that most of the fruits produced were domestically consumed and their prices were relatively stable. Recently, however, such fruits as longan, mango, grape, banana, etc., have been exported in large quantities which have helped the country's export earnings. The most spectacular development has been the pineapple industry with about 16 units licensed and 14 in production. It is estimated that Thailand has emerged as the largest producer, processor and exporter of pineapple and pineapple products 14/. The important pineapple producing and processing provinces are Prachuab Khiri Khan, Petchburi, Chonburi, Rayong, Kanchanaburi and Lampang. According to the President of the Fruit Producers and Processors Association, the total exports of fruits and vegetables at present is US$ 180 million per annum, out of which pineapple alone accounts for US$ 150 million (as against US$ 120-130 million in the Philippines). He predicts a phenomenal growth and expansion of tomato production and processing in the immediate future, and in fact, the multinationals such as Heinz, Libbys, etc., are already in operation in Thailand, using the local product. It was confirmed that there has been a rapid economic progress in Thailand in recent years. In the context of fruit and vegetable processing, reference was made to the establishment of integrated agro-industrial complexes. The point was effectively made that while some other countries in the region had also achieved significant progress by inviting joint ventures and foreign investments, as in the case of Thailand, they could raise their own capital and also possessed the necessary management capabilities. The main assistance sought from outside was modern and sophisticated technology for processing, equipment and machinery.

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14/ Newsweek, June 27, 1988, Thailand, Asia's Emerging Superstar

Therefore, there was a clear difference in the pattern of growth and development of the industry in the country.

49. The post-harvest loss is estimated to be 25 per cent of the fresh fruit production. The loss occurs in harvesting and transporting from field to the market without proper packaging. There are many other contributory factors. Packaging has been identified as a serious problem. It is reported that in the north, a UNDP-assisted cold storage project has been successfully implemented. The main advantage is the conservation of energy in the running of the cold storage, and adoption of technology suited to local conditions. It is an innovative project, conceived and built by indigenous expertise. The Royal Project is a charitable organization established in 1969 with the purpose of developing a permanent productive system of agriculture for mountainous regions of northern Thailand. In addition, a packaging development centre has been established at the Thailand Institute of Scientific and Technological Research (TISTR), and packaging of fruit is one of the main research activities being carried out at the Centre. Although fruit crops have been increasing in importance every year, their share in the value of farm productions is only about 11 per cent. In terms of land use, the orchard area represents only about 4 per cent of total agricultural land holdings. The export earnings from both fresh and processed fruits has increased from Bht 133 million in 1973 to Bht 3,032 million (US$ 120 million) in 1982, which constituted only 3 per cent of all agricultural exports. Processed fruits account for about 80 per cent of all fruit exports. In general, the prospects of area expansion is very limited due to many constraints such as high cost of orchard development, lack of suitable soil and climate and the fact that fruit farming requires special management expertise. During the last decade, fruit cultural practice and technology have improved rapidly. Fruit farms are gradually moving towards commercial scale farms. Though production cost is high as compared with other crops, the net return per unit are is also very high. In general, the economic well being of fruit growers is better than rice or other crop growers.
Post-harvest technology has drawn the interest of many research institutions and some progress has been made in the treatment and handling of fruits after harvest and packaging. Grower forums and/or associations play an important role in fruit production technology. Currently, fruit marketing is generally free from government intervention.

50. It is urged that the government agencies responsible for trade need to have strong, aggressive sales programmes to seek wider foreign markets for fresh fruits and processed fruits. Exportable crops are in great demand in foreign markets and their production is increasing because of the higher price realized or better profitability. It is stated that the statistics related to fruit crops are limited and not very reliable. It is suggested that official fruit crop surveys should be initiated as soon as possible and conducted on a regular and recurring basis, to provide timely and reliable statistics which are essential for long range planning and policy decisions to support the expanding fruit industry in Thailand.

INDIA 15/

51. There is a general belief that the potential for the production of fruits and vegetables in the country has not been fully explored, much less developed. Therefore, the processing industry has developed only to a limited extent. In view of the advantage of both tropical and sub-tropical climatic conditions prevailing in the country, the potential seems to be immense. The development of this sub-sector would also serve the policy objectives of the government, in providing employment, income/distribution, augmenting a valuable and nutritious source of food for the consumption of the growing population, and also to increase export earning. It is, therefore, considered in some quarters that it is a neglected subsector within the agro-based industries in the country. The Central Government at New Delhi has announced, in June 1988, the creation of a new Ministry of Food Processing Industries, emphasizing the new importance and priority accorded to food processing industries.

52. The estimated production of fruits and vegetables in the country is 54 million tons per annum, out of which 30 per cent of the harvest goes to waste i.e., 16 million tons simply perishes, for want of storage capacity, and marketing outlets. The inadequacy in the number of processing units have

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15/ Reports of the Central Food Technological Research Institute, Mysore, India.

also led to violent price fluctuations in the cost of fruits and vegetables, because of the seasonal nature of the produce, and the long distances, separating cultivation, processing, consuming and exporting centres. Thus, while particular vegetables or varieties of fruit are sold at distress prices, in the interior parts of the country, the consumption and export centres, such as Bombay starve for want of fruits and vegetables.

53. India is one of the largest producers of fruits and vegetables in the world, the cultivation extending over 5 million hectares, and the production is estimated to be 54 million tons, per annum. In 1985, there were 3000 units licenced to process these commodities. The total installed capacity was 380,000 tons, but the production was 140,000 tons of processed items such as juices, pulps, nectars, pickles, preserves, jams and jellies, etc. Out of the total output, 55 per cent was consumed domestically and 45 per cent exported. The capacity utilization seems to have stabilized around 35 per cent overall. Undoubtedly, there are wide variations in the efficiency of operation of different plants, and hence, the utilization of installed capacity. The total estimated output of the industry is Rs. 150 crores. (10m.=1 crore) (1$=RS. 13.50). This is about 0.4 per cent of the manufacturing industry and less than 0.1 per cent of the GNP. Its exports of Rs. 58 Crores contributes 0.5 per cent of the total exports of the country.

54. The contribution of this sub-sector to the GNP, its ability to add value to highly perishable commodities, its contribution to rural incomes and their stabilisation, its share in the provision of nutritious food to the population, and its role in generating foreign exchange earnings, are all exceedingly small as compared to its existing potential on the basis of the quantum of fresh produce and the relative contribution of the industry in other developing contries. As an illustration, Brazil's estimated production of orange juice concentrate alone is 600,000 tons per annum, (over 4 million tons of fresh oranges are used) out of which 550,000 tons of orange juice concentrate is exported, resulting in a foreign exchange earning of U/S/$ 660 million. Nearer home, smaller countries such as the Philippines and Thailand export substantial quantities of canned pineapple valued at US$ 120-130 million and US$ 150 million respectively. By comparison, the total of export earnings from all fruit and vegetable products is about Rs. 58 Crores

($40 million) in India. According to the latest information, Thailand has emerged as the single largest exporter of canned pineapple, as has been stated in the country report on Thailand.

55. The reasons for the relatively minor contribution of this industry have been ascribed to the following constraints:

-Poorly organized horticultural production system, which results in fresh produce of indifferent quality. In other words, there is no horizontal integration for the production of horticultural products as industrial raw materials of uniformly high quality.

-Low productivity, in view of traditional practices in production sold at high prices.

-Out-moded technology in processing, which is not cost-effective.

-Use of unsuitable and inadequate packaging materials to maintain quality and to withstand transportation over long distances.

-Relatively high level of direct and indirect taxation making the product uneconomical for large-scale domestic consumption.

-Inadequate incentives, which presumably is the view of the exporters, which makes the Indian products not competitive on export markets.

-Lack of policy directive to develop this industry, and having not realized the immense potential for its development, and the consequent benefits to the economy.

56. The per capita availability of fruits and vegetables in India is estimated to be 205 grams per day, as against a recommended level of 280 grams, and in most of the developed countries it is 300 grams. Similarly, per capita consumption of processed products derived from fruits and vegetables is insignificant in India, which is about 75 grams per person, per year, as against 15 kg in the industrialized countries. The National Horticulture

Development Board, which will provide the necessary institutional and policy framework for an integrated development of the industry, is said to be operational.

57. On the positive side, it is stated that a coordinated approach has been envisaged, to integrate the production, processing, and marketing of fruits and vegetables. Its important features are strengthening the existing community canning units, and their expansion to cover rural and semi-urban areas; establishment of agro-industrial complexes (conceptually integrated with the raw material production on a large-scale, over thousands of hectares to maintain uniformity of quality and to reduce the production costs, industrial processing by employing modern technology, and the utilization of byproducts, and also integrating marketing and distribution of the products, all under a single unified management). Such complexes are proposed to be established in Madhya Pradesh, Tamilnadu, Kerala, Maharashtra, Uttar Pradesh, and Karnataka. Further, production of fruit juice concentrate is also a means of conserving seasonal gluts and reducing transportation and packaging costs.

58. Concerning the food safety and regulatory measures in India, the following arrangements have been in existence for over three decades:

-The Prevention of Food Adulteration Act (PFA), effective from 1955 and amended in 1976, protects the consumers against adulteration cheating, sale, storage and distribution and misbranding of food products.

-The Committee on Food Standards with its various sub-committees, and 85 food laboratories established at district, regional, and at state levels assists in the administration of PFA. Four regional food laboratories established under the PFA at Ghaziabad, Mysore, Poona and Calcutta analyze food samples, and give expert advice where the reports of the public analysts are challenged by vendors or courts of law.

-The Indian Standards Institution (ISI), constituted under an act of the Indian Parliament, deals with the standardization of various products, including food products. A voluntary certification scheme is in operation.

-The Directorate of Marketing and Inspection, in the Ministry of Agriculture, has been operating a certification scheme of agricultural (raw and processed) commodities for consumer protection. This certification is compulsory for most foods meant for exports.

59. It is stated that there are no standards for machinery used for fruit and vegetable processing. The Indian Standards Institution (ISI), has developed standards for dairy and many other food processing equipment, but has not yet formulated standards for the fruit and vegetable processing machinery. However, machinery manufacturers do manufacture equipment for this industry, but they are according to their own design and convenience. This results in variations in processing capacities, performance, and quality of finished products 16/.

60. It would seem necessary to mention that the Government of India has a number of organizations set up to take care of the external trade interests of various products. The Processed Food Export Council is one such organization which has been wound up and in its place, the Agricultural and Processed Food Products Export Development Authority (APEDA) 17/ has been established by an act of the Parliament.

26. A publication of the Asian Productivity Organization (APO) 18/ contains a comprehensive report on the regional survey and country papers on Cook Islands, India, Indonesia, Japan, Republic of Korea, Malaysia, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand and Western Samoa on fruit production and marketing. The publication is based on the proceedings of a symposium. In the following paragraphs information relevant to the regional

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16/ Beverages & Food World Annual, (India), 1985-1986, The Processed Foods and Vegetables Industry, pp 65-66.

17/ Food Exports: The Indian Experience, a paper presented by the Chairman, APEDA, at a Food Conference held at the Central Food Technological Research Institute, Mysore, India, 1988.

18/ Fruit Production and Marketing in Asia and the Pacific, Asian Productivity Organization, 4-14 Akasaka 8-Chome, Minato-ku, Tokyo 107, Japan, 1985.

issue paper for UNIDO Consultation is extracted and a brief reference is made especially to the country situation of the countries which have not been referred to so far.

62. In most developing countries the trend in total fruit production has been essentially on the increase during the last decade. Apple and grape production in the Republic of Korea, the production of pineapple, banana and mango in the Philippines, guava and papaya in Indonesia and citrus in Pakistan, exhibited gains. Malaysia's production of durian, rambutan, banana, pineapple and mano also increased. In Thailand, it is said that pineapple production is price sensitive whereas in the Philippines exports is cited as an incentive for increased production. Even for Cook Islands and Western Samoa the prospects of fruits as potential foreign exchange earner is influential in their increasing production.

COOK ISLANDS

63. Fruit production is the most important agricultural activity in the Cook Islands. Citrus, banana, pineapple are the major fruits grown in the Islands. Citrus, either for fresh fruit or processing is the most important fruit and is grown mainly in Rarotonga. In the past citrus fruit processing has represented 40 per cent of the total value of commercial output. In recent years this figure is reported to have dropped.

64. The exports of banana, pineapple, papaya and citrus go mainly to New Zealand and only small quantities are exported to other countries. Private marketing agencies have been encouraged to do the marketing, in place of the primary produce Marketing Board of the Ministry of Agriculture.

65. A cooperative society of growers and exporters of fresh fruits and vegetables has been organized in Rarotonga. The post-harvest loss in transport, storage and handling is reported to be more than 20 per cent.

INDONESIA

66. The total aland area of fruit crop produced and harvested is estimated to be 600,000 ha. with a production of 5.3 million tons. The obstacles have been listed as poor quality seed, lack of capital and substantial post-harvest losses due to unavailability of processing plants for fruits and fruit products. The seasonal fruit trees are mango, durian, rambutan, mangosteen and citrus and year-round group of fruits which include pineapple, banana, papaya and jackfruit. Other important fruits are orange, guava and grape.

67. Under the Ministry of Agriculture, the Directorate General of Food Crops (DGFC) and the Horticultural Research Centre (HRC) are two agencies concerned with the promotion of fruit production and marketing. The DGFC is responsible for agricultural technology transfer or extension services, fruits included. HRC is responsible for undertaking research on fruits and vegetables.

68. In a 6-year projection target of DGFC for increased acreage and production of fruits a target of 764,000 ha. area and production of 8.2 million tons has been proposed.

69. In spite of priority being given to other more important crops in the Five-Year Development (Replita) Plan, there has been an increasing realization of the special importance of fruits and vegetables, as sources of food, rich in vitamins and mineral ingredients.

REPUBLIC OF KOREA

70. The fruit crops of great economic importance in the country are apple, pear, peach, grape and orange. The importance of the fruit crops in the country's agricultural economy is illustrated by the fact that the area planted to orchards almost doubled from 55,000 ha. in 1971 to 100,000 ha in 1981, whereas the total arable land even decreased from 2.13 million ha. to 2.05 million ha. as well as the cultivated land from 2.27 million to 2.19 million ha. during the same period. In terms of absolute value that of fruits was small but it increased by 12 times between 1971, of W 27.87 million to W 324.90 million in 1981 (1 US$=750 Korean Won), second only to the rate of

increase in the value of fishery which was some 19 times. Among the six major fruit crops the value of their output increased during the period from 6 times each year for pear, to about 38 time for orange. The value of grape output increased by 15 times, while those of apple and peach increased by 10 times each year during the same period.

71. It is stated that there are a lot more of other fruits grown and the total domestic production is estimated to be 732,600 tons with a net availability of 730,000 tons or per capita availability of 20 kg/year.

72. The production of processed fruit in total in the country has generally increased from 9.7 thousand tons raw fruit equivalent in 1971 to 55.3 thousand tons in 1982. Whereas there were only 45 fruit processing establishments in 1977, this number has increased to 57 by 1980 and stayed at that level in 1982. The processing of fruit juice has made a remarkable progress from 29 tons raw fruit equivalent in 1971 to 17.279 tons in 1982. This progress was followed by the production of canned fruits from 9,661 tons in 1977 to 55,316 tons in 1982.

73. Government policies are oriented to increase the production. The projected target is to achieve a production of 1.3 million tons by increasing the area from 91,000 ha. to 107,000 ha. over a 5-year period.

MALAYSIA

74. The Malaysian fruit industry is important socio-economically because it is estimated that not less than 135,000 small holders are involved in fruit cultivation. Furthermore, Malaysia normally imports about M.$.100 million (US$= 2.35) worth of fruits per annum, while its export amounts to about a third of this value. Although efforts have been made to develop the fruit industry, less emphasis is given to it compared with cultivation of rubber or oil palm, due to the belief that fruit cultivation would not generate a high net return. Fruit production in Malaysia could be financially rewarding giving a high net return if production could be raised to a high enough technological level, especially for the small land holders. The basis, therefore, exists for a long-term, stable commercially viable fruit industry in

Malaysia supplying local demand as well as for export.

75. Fruit cultivation extends over 76,453 ha and among the popular fruits are durian, rambutan, banana, pineapple and mango. Most fruit cultivations are mixed and about 11.7 per cent are mono-cropped in which pineapple is the most important. The cultivation rarely exceeds 2 ha. in each farm, and is generally uneconomic and not viable, let alone its transportation, handling and marketing problems.

76. Insufficient supply and availability of seasonal fruit types is a constraint to the Malaysian fruit processing industry. Inevitable this would lead to the high cost of processing, while at the same time the consumer preference for the processed local fruit product is low compared with the imported fruit product. Recent developments in the Malaysian fruit industry have indicated a better future for the industry. Large-scale cultivation of local fruits by private and public enterprises have emerged. The government has recently outlined a long-term plan for the development of the fruit industry. It is anticipated that the government will play a dominant role in providing incentives to ensure that the fruit industry will become commercially viable. Through the courtesy of the Regional Representative of the United Nations Development Programme in Kuala Lumpur, a report on the Food Processing Industry was received, which, inter alia, refers briefly to fruit and vegetable processing and stresses on pineapple canning (output 52.2 million ringgit, US$=MS ringgit 2.35). The report does not elaborate on the processing of vegetables except to remark that the production is insufficient for processing.

NEPAL

77. The soil and climatic conditions in the Terai, including sizeable portions at the lower slopes of the mid-hill areas are favourable for growth of various tropical, subtropical and temperate fruit crops. The four leading fruit crops are mandarin, mango, apple and banana. The total area planted is 44,690 ha. and the total production is 316,000 tons. It is estimated that only about 17 per cent of the farmers growing fruit crops grow them on a commercial scale. More than 90 per cent of the commercial fruit crop growers are small

holders. Only a few commercial orchards are in existence. The basic constraint in commercial fruit growing is the fact that since fruits themselves are not staple food, they receive a lower priority than the staple crop like cereals. The other factors are (a) long gestation period of the crop; (b) high initial investment; (c) absence of adequate storage and marketing facilities; and, (d) lack of know-how among farmers of modern fruit production.

78. It is estimated that the post-harvest losses occur in varying proportions with each of the four major fruits as follows: (a) handling/transport, apple 25-40 per cent; mango 15-20 per cent, and mandarin and banana 5-10 per cent; handling: banana, 10-15 per cent mango and apple, 10 per cent each, and mandarin, 5 per cent. In the UNIDO publication "Nepal, Industrialization, International Linkage and Basic Needs" (Document PPD. 79) it is reported inter alia that another important segment of the food manufacturing branch is the fruit processing industry. A wide variety of fruit is grown in Nepal and current research is actively promoting the cultivation of other fruits which are not traditionally grown in the country. The harvest periods for fruit show that raw materials could be available throughout the year. However, analysis of their location of growing area shows that they would be dispersed between the three climatic regions of the country. Although transport and communication could be possible between Terai and lower hills locations, combining all three would prove too difficult due to the perishability of fruit after harvest.

79. Total fruit production at the end of the Sixth Plan period in 1985 was estimated at 343,204 tons, and is expected to rise to 461,743 tons by 1990. Priority areas are also shown in the Seventh Plan by region with the major emphasis being placed on the production of citrus. The aims of the Plan are:

1. To increase the consumption of fruit in order to improve nutritional standards;

2. To achieve self sufficiency in the production of apples, citrus fruits, bananas, pineapples, mangoes, pears and grapes; and,

3. To increase fruit production from 343,000 tons to 462,000 tons by 1990.

80. Field reports indicate that there is sufficient capacity for processing of fruits into squash, juice, jelly, jams and slices. It is estimated that by 1990 the projected demand for processed fruits in Nepal will be 364.3 tons, while the present processing capacity is already 2,893 tons per annum. This capacity includes a new plant, Nepal Beverages and Food Products Ltd., which is a joint venture with the Kissan group in India - only 10 per cent of the output of this plant is destined for domestic consumption. The Sarlahi fruit processing plant commenced production in 1985. It has a capacity of 418 tons of processed fruit per year.

81. Scope also exists for the expansion of vegetable processing in Nepal. The Ministry of Agriculture has estimated that there are sufficient vegetables to supply 49 kg per head per year, i.e., an output of 741,600 tons of various vegetables but excluding potatoes. The Seventh Five-Year Plan proposes to increase the availability of vegetables to 970,000 tons, which is expected to be achieved by concentrating production along lines of communications and around urban areas. The proposed increase in output involves an increase in area from the present 138,000 hectares to 140,500 hectares; the average yield per hectare is expected to be 5.37 tons. Development of the vegetable processing industry relies on close collaboration with the grower, good technical management, a high degree of quality control and grading, entrepreneurial skills and a knowledge of export market opportunites. Co-ordination of these skills and factors are the main constraints on the expansion of vegetable processing in Nepal.

PAKISTAN

82. Pakistan produces citrus, mango, date, banana, guava, apple, plum, apricot, pear, pomegranate, grape, almond and peach. Except for almond and peach all the other fruits amount to 30,000 tons, each. The total area planted is 330,000 ha. and the total production is 1.5 million tons.

83. Greater emphasis is being laid by the Government on the production of fruits and vegetables. Special efforts are being made to expand their

production as well as local trade and exports. In agricultural marketing a public sector agency, viz. the Agricultural Marketing and Storage Ltd. has been established for creating a link between the producers, traders and consumers of perishables, including fruits as well as to undertake their export. Government horticultural organizations in the provinces undertake specialized research on fruits and vegetables under the purview of the Pakistan Agricultural Research Council (PARC). A special department for providing guidance on development and research in the production of fruits and vegetables has been created. These are some of the measures that have been taken. These measures aim at increasing yield, improving quality and expanding the area and production of fruits and vegetables.

84. A Fruit and Vegetable Board at the federal level under the Chairmanship of the Minister for Food and Agriculture and a similar board in Sind have been set up to provide policy guidelines for developing the fruit and vegetable sector in the country. Liberal agricultural credit, plant protection measures, and a system of grading and quality control in export trade have been introduce by the government.

85. Fruit and vegetable losses estimated at 15 to 20 per cent of total production are caused by deterioration. Part of the solution to this problem is the preservation of fruits and vegetables through processing. This industry in Pakistan is not sufficiently developed so as to utilize a sizeable proportion of production which otherwise goes to waste.

SRI LANKA

86. The fruits of economic importance are passion fruit, pineapple, banana, mango, papaya, lime, orange, cashew nut, bread fruit and jack fruit. The total production is estimated as 150,000 tons per annum. The total land area under fruit crops has increased to 83,800 has. The plantation type of fruit cultivation is not common in Sri Lanka. However, a few companies in recent times have embarked on this type of cultivation such as pineapple, passion fruit, banana, mango, cashew nut, etc., and some plantations of passion fruit and banana run by such companies comprise 20 to 40 ha each. For the management of these large-scale plantations, the companies engage agriculture

college graduates or diploma holders with 10-15 other permanent employees. These companies specialize in one or two crops and may not own processing plants.

87. No study has been done so far on the extent of quantitative and qualitative losses incurred in fruit production between the period from and after harvest up to the time of consumption. However, some studies at the Agrarian Research and Training Institute of Sri Lanka on fresh vegetable transport from farm gate to the consumer in Colombo indicate that 22 per cent is wasted in transit. Since fruits are also transported in the same manner as vegetables packed in gunny bags and dumped in lorries or trucks, fruit wastage in transit could be as much as vegetables. The main causes of post-harvest losses are as follows: (a) fruits are harvested before maturity, specially in the case of mango and avocado; (b) inefficient method of harvesting, e.g. in the case of banana, the farmer cut the bunches and dump them one on top of the other, on grass; (c) frequent droughts in the dry zone affect fruit trees and fruit tastes, colour, etc.; (d) rough handling at farm gate and in transit from out station areas to Colombo; (e) unsatisfactory selection of fruits from heaps at farm gates. Traders purchase from a mixture of good and bad, mature and immature, often spoiled fruits; and, (f) unsatisfactory packing methods in local transport.

WESTERN SAMOA

88. Geographically, Western Samoa's smallness in size and isolation from major industrially developed countries dictate somewhat the pattern of development taking place in this independent state. Western Samoa's current population is estimated at 162,000. The economy is principally agriculture-based, deriving 90 per cent of export earnings from farm commodities mainly coconut, taro and cocoa.

89. The pre-independence export of fresh fruits in 1960-61 were avocado 500, citrus 275, mango 100, papaya 2,300 and pineapple 90, standard cases (16 lbs each case). The post-independence exports of fruits have shown a remarkable increase but precise figures are not available. The new fruit crop, passion fruit, has developed to be a major export commodity as pulp, and sold locally

as fruit juice. Bread fruit is most common and a widely used fruit in the country, as it is practically a staple food for Samoans. Only small quatities of bread fruit are exported and attempts are being made to process it into flour for greater and more economical exportation. Citrus has always been a popular fruit and will be so for many years to come. Grape fruit was exported to New Zealand until 1960 when the only producer ceased growing it in favour of other more profitable fruit crops. Local orange and mandarin, when in season, will supply the local market as well as American Samoa. Therefore, production of these fruits is expected to increase in order to compete with other sources supplying the foreign markets. Strict quarantine regulations in importing countries restrict the export of fruits and vegetables from Western Samoa. Otherwise, foreign demand continues to exceed supply.

90. As export commodity, fruits are potential foreign exchange earners particularly avocado, mango, pineapple, and papaya, given the fact that a new and larger international airport is nearing completion (perhaps already completed) which should enable shipments of large quantities of fruits to New Zealand and Australia. Equally promising is the export of processed fruits, since fresh fruits are very seasonal, particularly passion fruit, the potential of which has already been demonstrated.

## VI. REGIONAL VIEW OF THE PROCESSING OF FRUITS AND VEGETABLES IN TERMS OF THE ISSUES FOR DISCUSSION

91. While it is difficult to generalise the situation in the vast region of Asia and the Pacific, the following observations would seem to present a factual account of the state of affairs:

The region as a whole has tremendous potential for increased processing of these two commodities. Firstly, being agricultural products the value added has the advantage of employment generation, income distribution, provision of nutritious food and also potential for large-scale foreign exchange earnings. It has been discussed earlier that as a practical demonstration of an agro-based industry, it will strengthen the linkage between agriculture and industry. So much for its economic and social importance, especially for countries whose economies are largely based on agriculture.

The root cause of the lack of development could be traced to poor agricultural productivity, with low yield per hectare, and thus making the raw material expensive and perhaps with wide variations in quality. There are, however, notable exceptions such as the Philippines and Thailand, where the productivity is reported to be high.

In the processing technology, we find the same situation. While the more progressive countries have adopted modern technology and their products are competitive in the export markets, it is not true of a number of other developing countries which have comparative advantage in resources, but have not exploited this advantage due to a variety of reasons which have been discussed in different forums at technical, inter-governmental, and global level consultations as also the IDB meetings, and UNIDO Conferences.

While the obstacles and constraints have been listed, viz. high transportation costs, lack of storage facilities, lack of modern processing facilities, most prohibitive cost of packaging, and the heavy burden of multiple taxation, the few progressive countries seem to have overcome these constraints, but a majority of them seem to find it difficult to solve the problems, either because this industry is not accorded a priority status for development, or the policies are not entirely conductive for their development.

Therefore, the most critical point that emerges is that the policies and strategies of the government concerned should be reoriented for building a strong and viable agro-industrial base, and to this end, there should be a commitment to provide necessary incentives and infrastructure which is most essential, for the dynamic private sector to flourish and to attract private foreign investment. The removal of restrictions and liberalization of policies will attract unlimited foreign investments, and inflow of modern technology, which will provide a solution to the intractable problems of some of the developing countries in the region.

Notwithstanding the general constraints encountered in the developing countries, a special tribute should be paid to the ASEAN countries which

have made headway in the development of the agro-and allied industries, as the economic indicators have confirmed. It is worth repeating that Thailand has emerged as the most dynamic and progressive country, and in the deliberation in April this year, reference was made to the fact that Thailand was quickly moving in the direction of being included in the exclusive club of Newly Industrialised Countries (NICS).

It is interesting to observe that when liberal policies are adopted, as in the case of ASEAN countries, the constraints and obstacles seem to get resolved by the industry, because industry is established on businesslines, and the identity of national interests is readily recognized by the parties concerned, including those in power and authority.

92. A significant feature at the regional level is to promote regional cooperation. ESCAP has been a pioneer in spearheading a large number of regional and inter-country projects in the past. Considerable work has been done in the agricultural commodities production, processing, and marketing, for e.g. coconut, rubber, pepper, oilpalm, timber, silk, dairy, essential oils and medicinal plants, leather and leather products, jute, etc. All these would not have been possible without the active technical and financial support and cooperation from the global organization, UNIDO. At the subregional level, ASEAN has forged a number of sub-regional projects and prominently in the food processing industries, which includes processing of fruits and vegetables.

93. In the section entitled Conclusions, certain observations and specific proposals have been made for the deliberation of the regional preparatory meeting at Beijing, to enable it to arrive at suitable decisions and to provide guidelines for future action by UNIDO at the global and inter-regional level; at the regional level, by appropriate agencies; and by the countries themselves at the national level, if necessary, with technical cooperation from UNIDO and other sources.